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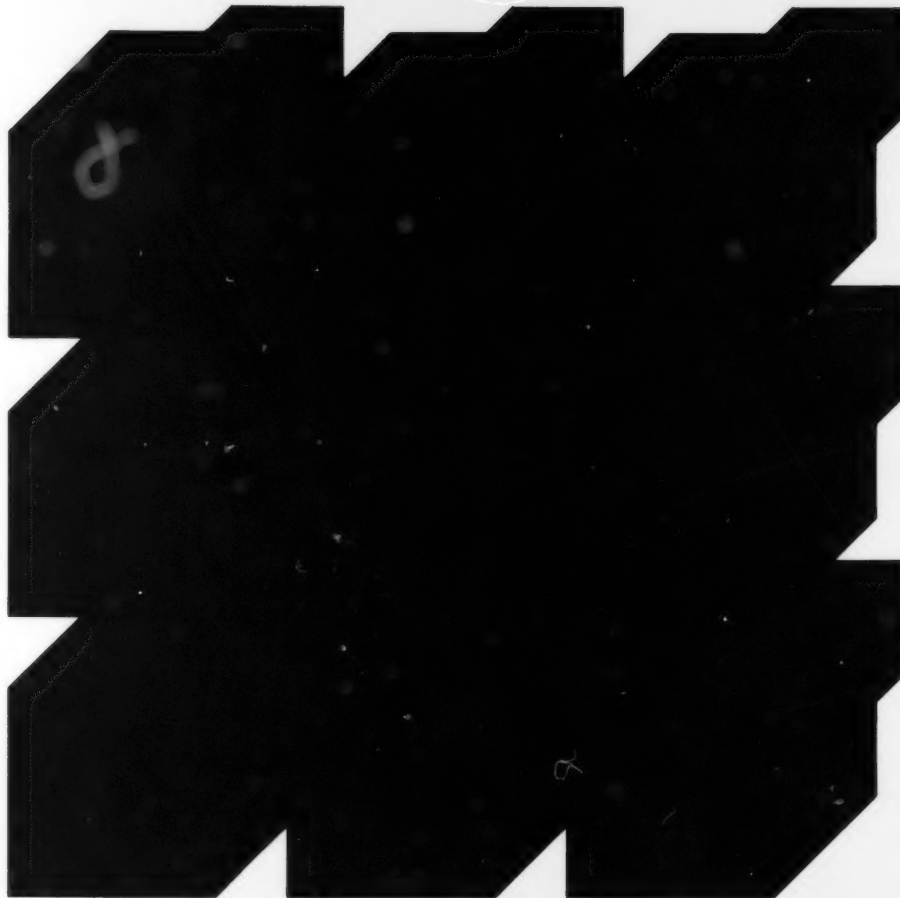


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DISCUSSION PAPER NO. 365

Estimation of Canadian Human
Capital Stocks and Flows: What
Can Be Done?

by

Harry H. Postner

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RÉSUMÉ

Les deux objectifs premiers de cette étude sont de 1) faire le point sur les ouvrages traitant de l'estimation des stocks et du flux du capital humain, et 2) de proposer une méthode et des moyens d'estimation régulière des stocks et du flux du capital humain du Canada. L'étude examine trois méthodes qui sont principalement employées à cet effet. On associe d'habitude la première méthode, dite de rétrospection ou "du coût des ressources", aux ouvrages de John Kendrick. La seconde, dite de prospective ou de "valeur actuelle" et qui est connue depuis longtemps, suscite actuellement un regain d'intérêt. La troisième méthode, dite "du dos de l'enveloppe", est de découverte et d'utilisation toutes récentes.

L'étude montre que les deux premières méthodes peuvent produire, et produisent effectivement, des estimations empiriques fort divergentes quoique réconciliables jusqu'à un certain point, de l'ensemble des stocks et des flux. De plus, les résultats produits par chacune de ces méthodes différeront fortement entre eux suivant les diverses hypothèses utilisées. Mais surtout, ces méthodes compliquées produisent des estimations souvent difficiles à interpréter. Par exemple, la méthode de rétrospection ou du "coût des ressources" présente des difficultés sérieuses sur deux plans : 1) la différenciation des données sur les composantes de flux de consommation de celles sur les flux d'investissements des dépenses au titre du développement humain et 2) la détermination de ce qui constitue empiriquement des sources potentielles de capital humain, c'est-à-dire le problème de l'identification.

Pour le moment, la méthode du "dos de l'enveloppe", une technique elliptique de calcul à partir d'hypothèses assez solides, apparaît comme la méthode la plus efficace d'estimation approximative des stocks et flux du capital humain du Canada. Le document comporte, effectivement, une application de cette méthode à l'économie de marché canadienne de 1988. Nous avons constaté qu'environ 60 % de la richesse canadienne (calculée sur une base brute consolidée et par rapport à l'économie de marché intérieure) qui produit des revenus consiste en stock de capital humain canadien. La technique ne possède, en réalité, qu'une "valeur intérimaire" en attendant qu'un consensus s'établisse au sein de la profession sur une méthodologie plus élaborée et plus exacte pour obtenir des estimations régulières (annuelles) des stocks et flux de capital humain.

Les deux dernières parties de cet ouvrage - la conclusion et la postface - tentent surtout de souligner certains problèmes qui continuent de se poser pour l'estimation du capital humain et sur lesquels il faudrait maintenant se pencher. Par exemple, l'usage limité, à l'échelle des entreprises commerciales, de la "comptabilité des ressources humaines" pourrait nous être éclairant. Nous pourrions tirer avantage également des nouvelles

pratiques instituées dans le domaine des comptes satellites, dont l'usage a d'abord été répandu en France. Par ailleurs, la question de l'entrepreneurship suscite un large intérêt. L'analyse détaillée que Marc Casson en a faite nous fournit de précieux renseignements sur le rôle du "capital humain des entreprises" qui agit comme catalyseur dans le rassemblement des composantes conventionnelles du capital humain. (Il accorde beaucoup d'importance à la notion de "souplesse mentale" et à la façon de la favoriser).

Enfin, nous rappelons brièvement que le but du système d'éducation est d'accroître le capital humain positif, alors que celui des tribunaux d'instance criminelle est de réduire le capital humain négatif. Cependant, aucun de ces systèmes ne possède de comptabilité adéquate du capital indiquant le résultat net de leurs activités.

ABSTRACT

There are two original aims of this paper: (1) to survey the literature on estimation of human capital stocks and flows, and (2) to suggest a method and means of estimating Canadian human capital stocks and flows on a regular basis. The paper examines three main methods of estimating human capital stocks and flows for a nation's economy. The first method is called the retrospective (or "resource-cost") approach to estimation and is usually associated with the work of John Kendrick. The second method, the prospective (or "present-value") approach, has been known for a long time and is currently undergoing some revival of interest. The third method, the "back-of-the-envelope" approach, has only recently been "discovered" and implemented.

The paper shows that the first two approaches can and do yield widely different empirical estimates of aggregate human capital stocks and flows, though some degree of reconciliation is possible. There are also significant differences between the results obtained within each method, depending on the application of various assumptions. Most important is the fact that the two methods are cumbersome to implement and the resulting estimates are often difficult to interpret. For example, the retrospective ("resource-cost") approach has two major problems: (1) the split-off between the consumption flow and investment flow components of human development expenditure data, and (2) the decision as to what empirically constitutes the potential sources of human capital, i.e., the identification problem.

At this point it appears that the "back-of-the-envelope" approach to estimation, a strictly short-cut procedure based on fairly strong assumptions, is the most cost-effective method for obtaining "ball-park" estimates of Canadian human capital stocks and flows. Indeed, the paper contains an application of this method to the Canadian market economy for the year 1988. It turns out that Canadian human capital stock probably comprises about 60 per cent of total Canadian income-producing wealth (on a gross consolidated basis) and measured with respect to the domestic market economy. The procedure, in effect, has an "interim value" pending the realization of a professional consensus on a more elaborate and more accurate methodology needed for estimation of human capital stocks and flows on a regular (annual) basis.

The last two sections of the paper, a Conclusion and Postscript, are mainly devoted to outlining some of the outstanding problems and related issues in the human capital area that now require some resolution. For example, something could

be learned from the limited use of "human resource accounting" at the level of the business firm. We might also benefit from recently established practices in the field of Satellite Accounts, originally pioneered in France. The subject matter of entrepreneurship is presently very popular. Some in-depth analysis of this area by Marc Casson sheds important light on the role of "entrepreneurial human capital" as a catalyst for putting together the conventionally-recognized ingredients of human capital. (A major role is given to the notion of "mental flexibility" and how it can be stimulated).

Finally, we briefly note that while the educational system is intended to increase positive human capital, the criminal justice system is intended to diminish negative human capital. But neither aspect presently possesses an appropriate capital accounting with an operational "bottom line".

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FOREWORD

This paper was originally prepared as a background document for the Economic Council's Project on "Visions of Canada in the Year 2000." Since the exposition is mainly nontechnical, it is hoped that the paper could stimulate wide interest in the subject matter.

Conceptually speaking, there is nothing very mysterious about human capital. The paper shows we are not wasting our time looking at human capital, its problems and prospects. But there are severe limits to what can be done with the concept of human capital alone, without empirical estimation and identification. Here we need more understanding of the basic measurement issues; more understanding among academics and practitioners alike.

A large part of this paper was originally presented at an in-house seminar held at the Economic Council in November 1988. Sincere thanks are due to participants at that seminar for stimulating comments and questions. Some of the ideas raised at the seminar are reflected in this paper's Postscript which also serves to bring the material up to date.

The paper, in effect, is an introduction to what we hope will be much more Canadian work on human capital in the near future.

Judith Maxwell
Chairman



"Whether national wealth should include an allowance for human capital, i.e., capitalized net earning capacity of the members of the community, is no problem at all from the viewpoint of national business accounting. Since personal earning power is nontransferable under present legal arrangements, it cannot become the object of a purchase or sale or valued for balance sheet purposes. It obviously does not appear in any actual balance sheet, and would not be so entered in any balance sheet, even for nonbusiness units, prepared according to the basic principles of present-day accounting. Hence, neither the balance sheets of ultimates or intermediaries nor, a fortiori, the national balance sheet contain any entry for human capital".

R.W. Goldsmith (1950)¹

I. INTRODUCTION

The field of human capital in economics has come a long way since the Raymond Goldsmith of 1950. The concept of human capital has been analyzed and refined due to the pioneering studies of Theodore Schultz and Gary Becker in the early 1960's. There is now a huge literature of empirical applications (the most recent survey is Rosen (1987)). Moreover some important researchers, such as Kendrick (1976) and Eisner (1985), have gone ahead and estimated total human capital stocks and flows for the U.S.A. in an extended national accounting context and compared their estimates with the more traditional physical stocks and flows at both the national and sectoral levels. Since no such estimates and comparisons have yet been made for Canada, it seems natural to ask: What can we do in this area of human capital?

The original purpose of the work reported in this paper was meant to be a contribution towards Canadian statistical data development. This writer's initial contacts with Statistics Canada and access to unpublished working papers produced by that institution, led to the belief that fruitful cooperation between the Economic Council and Statistics Canada might be possible in the area of estimation of Canadian human capital stocks and flows. These estimates seemed best performed in a national (and sectoral) economic accounting framework in order to assure statistical consistency and valid statistical comparisons. However, a more intensive review of the human capital literature and related issues, led the present writer to now conclude that such a joint undertaking is not to be recommended, given the state-of-the-art as it exists today. Indeed, the main contents of this paper are specifically devoted to the arguments for and against a joint program of estimation of Canadian human capital stocks and flows. In the process of following the arguments, it is hoped that the reader can learn something about the issues involved and, perhaps, most important: Where do we go from here?

The paper is written at a semi-technical level. It is assumed that the reader already has some acquaintance with the economic concept of human capital and with the rudiments of national accounting (references are given to the basic literature). Since the main conclusions of this paper are rather disappointing (one might even say "negative"), the exposition is kept relatively

brief and "to the point". Where the supporting arguments become purely technical, the paper provides references to the literature (particularly, when such references are readily available). We do, however, take the trouble to emphasize the early work of Theodore Schultz (1961) and some of his critics who originally raised the fundamental problems of empirically estimating human capital stocks and flows -- problems that have not yet been successfully resolved and problems that have tended to be overlooked by those who have simply gone ahead with such estimation. We also emphasize the crucial economic distinctions between human capital stocks and (non-human) physical capital stocks -- some of which are implicit in the leading quotation from Raymond Goldsmith (1950). These distinctions tend to preclude the validity of the kind of comparisons mentioned above.

Finally, it should be born in mind that the scope of this paper is mainly limited to the basic estimation problem and data development problem (in a national accounting context) already described. We do not become significantly involved in the more general economic policy issues relating to, e.g., future education and training or future health and medical programs, that might interest many readers. These popular issues, insofar as they relate to human capital estimation, are not entirely ignored. Readers are referred to Section VI "What Can Be Done in the Future?" for some relevant discussion. Indeed it will found that the conclusions of the paper are not entirely "negative". See

also the Postscript that updates this paper to reflect the most current literature.

II. BACKGROUND

In the official national accounting systems of Canada and other countries, expenditures on human development and related "intangibles" are all regarded as current consumption expenditures (rather than investment). This, in effect, means that outlays on education, training, health, safety, labour mobility (migration) and even research and development, are all classified as consumption expenditures, either intermediate or final. Indeed this convention hold true for each of the major sectors: households, business, and government, that actually finance such outlays on human resource development. (Private nonprofit institutions serving households are grouped as part of the household sector.) There are some historical and institutional reasons for this classification decision. The main points are: 1) the classification follows business accounting conventions; 2) human "capital" resources cannot be bought and sold in the market along the lines of non-human (physical) capital, i.e., differences in the nature of property rights between human and physical capital; and 3) the pervasive influence of Keynesian economics with the basic distinction between the consumption function of the household sector and the investment function of the business sector.

Yet during the past 25 years a whole new field of human capital theory and application has been constructed by economists such as Schultz (1963) and Becker (1964)² which treats human development expenditures as an "investment" rather than as "consumption". The field is basically motivated by the following economic principle. When an individual (or economic sector) undertakes expenditures, the effects of such outlays can be categorized into one of two types: 1) the benefits of the expenditures are realized in the same time period as when the outlays occur (say, a period of one year); or 2) the benefits are realized in future time periods and possibly after a considerable time of waiting. The first type of expenditure is categorized as "consumption"; the second type of expenditure is then called "investment". Since the individual (or economic sector) must wait for the benefits of investment expenditure, there is typically an expectation of a rate of return (or "yield") of investment over and above current expenditures (or "sacrifices"). Indeed this general economic principle is applicable to both tangible and intangible investments, no matter which individual (or economic sector) is responsible for the relevant expenditure.

So in contrast to business accounting conventions, property right distinctions and Keynesian economics, human development expenditures can and should be classified as investment (and appropriately accumulated into human capital stocks) if such

expenditures satisfy the basic economic principle explained above. And a good deal of the huge literature on human capital is devoted to showing that, e.g., education and training expenditures raise output-producing capacity and benefit incomes in the future rather than being used up (and consumed) in the time period when the outlays actually occur.³ Whenever such expenditures involve weighing future benefits against current costs, the principles of economic capital theory are applicable.

It is now easy to see that the present official practice of labelling all human development expenditures as (current) consumption, results in a considerable distortion in our view of the national economy and related economic analysis. There is a serious understatement⁴ of national savings and investment; our analysis of the factors behind national and sectoral economic growth become biased; our assessments of inter-sectoral relationships is mistaken; and it is difficult to trace the connections between current production, future consumption benefits and the financing of government and nongovernment activities in various social fields. In addition, our impression of the federal government budget position would be significantly different if many of the human development expenditures listed previously were classified as investment rather than consumption. Hence the subject matter is of considerable interest, particularly when approached within an extended national accounting framework.

(An introduction to national economic accounting can be found in Ruggles and Ruggles (1970)).

The case, then, for incorporating human resource development expenditures as an investment seems quite strong. Indeed, in evaluating alternative allocations of an economy's total resources, expenditures for (say) physical machinery and equipment and expenditures for (say) education and health, should all be considered in the same terms of reference. It would seem to be a serious error to classify expenditures on machinery and equipment as capital formation merely because they are tangible, and all education and health expenditures as consumption merely because they are intangible. The Canadian economy's efforts towards future economic growth should be measured in terms of resources devoted to both tangible (physical) and intangible (human) capital formation.

If all this is, indeed, the case and if the case is so clear cut, why have national statistical agencies not gone ahead and performed the required estimations? Why have these agencies, evidently, been so reluctant to adopt and adapt the procedures formulated by private investigators such as Kendrick (1976) and Eisner (1985) mentioned previously?⁵ And most important, what position should we recommend for the Economic Council (and, also, Statistics Canada) with respect to this issue? An attempt is made to answer these crucial questions in the following sections of the

paper. At the same time it is essential to critically analyze the two major estimation procedures for human capital stocks and flows that have been used by researchers in this area. In fact there is even a third procedure -- so simple that anyone can perform it on "the back of an envelope".

III. THE RETROSPECTIVE ("RESOURCE-COST") APPROACH

The retrospective approach to estimating human capital stocks and flows is, in effect, similar to that often used to estimate physical capital stocks and flows. One must first identify the particular expenditure data sources that would potentially contain, inter alia, the best available indicator of the "investment flow" of human resource development. Then there is the critical decision regarding the appropriate split of observed expenditure data into a consumption flow component and an investment flow component. Next, we would need a choice of expected useful life spans required to cumulate (and eventually retire) human investment expenditures over time into a human capital stock dimension. A fourth issue regards the subtle problems of human investment depreciation (or amortization) over time needed to transform the gross investment expenditure data into a net investment concept (and net capital stock dimension).⁶

All these aspects are faced, in one form or another, when estimating physical capital stocks and flows by the familiar

"perpetual inventory method" first introduced by Goldsmith (1951). However, when dealing with the technical estimation aspects of human capital, it will also be found that appropriate demographic accounting techniques are a useful complement to the above method, since stocks of human capital are ultimately embodied in the human population and labour force. It would then be possible to show how human capital stocks (of various categories) change as individuals enter the labour force and older persons retire or die.⁷ But for most human capital the amortization of the original investment expenditure over time will inevitably possess a certain degree of arbitrariness under the "rules" of the retrospective approach (see discussion in next section).

So far it would seem that the retrospective (resource-cost) approach is feasible, though a little more difficult to apply to the human capital area as compared to the non-human (physical) capital area. Indeed this is the approach utilized by empirical investigators such as Kendrick (1976) and Eisner (1985). Before continuing, however, there is one minor point that should be made. It is now becoming increasingly common to "check" (and "adjust") perpetual-inventory estimation of physical stocks with more direct survey observations of business firms' balance sheets and related market transaction data (sometimes after appropriate valuation modifications). This can be seen in some current work at the Bureau of Economic Analysis (1985) and Statistics Canada (1988). This path is, of course, not open to estimators of human capital

stock, so that the point made by Goldsmith (1950) in the lead quotation of this paper continues to haunt investigation in this area.⁸ But, as we shall see, there are (at least) two major pitfalls of estimation of human capital stocks and flows that are peculiar to the area when dealing with the retrospective approach. These pitfalls deserve considerable discussion.

In order to focus on essentials, the following discussion is limited to the two most important Canadian human resource development expenditures, namely: 1) education and training expenditures, and 2) health care and other medical (including safety) expenditures. In the year 1984, total education and training expenditures amounted to 7.8 per cent of Canadian GNP; total health and medical expenditures equalled 8.6 per cent of GNP.⁹ (These two major classes of expenditures are largely made by the Canadian household and government sectors and so the expenditures are mainly and officially categorized as "final consumption".) This means that we presently overlook human development expenditures on labour mobility (migration) and "human knowledge" expenditures on research and development (R&D). The former category is difficult to quantify and, by all accounts, of a much smaller order-of-magnitude compared to the education and health categories. The latter, namely R&D, is sometimes categorized as a non-human intangible resource development expenditure and will be taken up again later in the paper because

of its special characteristics (total R&D expenditures are currently running at about 1.3 per cent of Canadian GNP).

The first "major pitfall" concerns the decision criteria used to split human resource cost expenditures into a consumption flow component and an investment flow component.¹⁰ The originators of human capital theory in economics, particularly Schultz (1961), were very clear in stating that not all human resource (development) outlays can be classified as investment, i.e., the benefits of the various current outlays may or may not be realized in future time periods. The problem is that human resource expenditures, most of which are financed by the household and government sectors, are not typically subject to an "investment calculus" usually associated with business outlays on physical capital equipment and structures. There is a distinct element of subjectivity involved in what can be considered investment or consumption in this human area. With respect to physical capital stocks we have concrete guidelines in the sense that produced physical (tangible) assets, resulting from current expenditures, remain at least partly intact at the end of the accounting period. When dealing with intangible assets (such as education and health) the full burden of proof, as to whether there really is an "investment", falls on the basic conceptual distinction mentioned earlier. So while the distinction between physical assets and, say, consumption goods is generally clear-cut, the distinction between present-oriented and future-oriented expenditures is not

so clear-cut. We may claim, e.g., that education and health expenditures are relatively more future-oriented than expenditures on, say, food and entertainment, but that is all! There remains a consumption component of education and health outlays that may be substantial and cannot be "swept under the rug".¹¹

One way to handle this issue is to subject both education and training expenditures data and health care and medical expenditures data to an item-by-item consumption/investment analysis, perhaps with the help of (noneconomic) experts in the two fields. Although this suggestion has been made by certain investigators (e.g., Gates (1984)), the task has not yet been accomplished. It would appear that economists have had difficulty communicating their needs to noneconomic experts and that "experts" would themselves differ on the subject. Moreover, there is no reason why an "item-by-item analysis" should yield a consumption/investment allocation that must remain constant over time. Writers such as Rosen (1980) have closely questioned the "constancy" assumptions imposed by Kendrick (1976) and others. In fact Schultz (1961) gave a clear warning with respect to the "constancy" assumption: the consumption component of human resource expenditures has probably been increasing over time due to the phenomenon of "rising expectations" in an affluent economy. No one has yet even attempted to measure this phenomenon!

Some concrete examples may be helpful. Primary education and even part of secondary education are "compulsory" in most Canadian provinces. Indeed a good deal of early education is of the "baby-sitting" variety and even much of adult education contains an "entertainment" element. On the other hand, most higher professional education and formal on-the-job training financed by business are oriented to raising future real (marketable) incomes and output-producing capacity. So total education and training expenditures embody both consumption and investment components and it is difficult to know precisely where to "draw the line." With respect to health care and medical expenses, the many small expenditures on checkups, minor treatments and so on, do not yield long-run benefits. They are more in the nature of "maintenance costs" or consumption. Even the costs of providing the facilities of the health care system may not be included in human capital investment as argued by Gates (1984) in a careful analysis. These physical capital costs are not directly embodied in human beings and, therefore, are not part of human capital. On the other hand, the sum of the costs incurred during a year for human health care that yields benefits for a period longer than a year is gross health investment (i.e., less sick leave in the future, higher productivity during future working hours, greater longevity for labour force participation.) But implementing this basic guideline is again a difficult matter. The additional problems facing the consumption/investment split for health care and medical expenditures is that there is no natural marketability

criterion as often occurs with respect to formal education and training expenditures. Note, however, that health care expenditures (as well as education expenditures) for the retired human population are not counted as investment. This particular aspect is tracked and monitored by a complementary demographic accounting model mentioned earlier.¹²

Before turning to the second "major pitfall" it should be noted that the original human capital theorists such as Schultz (1961) envisaged a 3-way component allocation of human resource expenditures: 1) immediate "pure" consumption; 2) investment for future marketable benefits (i.e., higher real incomes); and 3) investment for future non-marketable (consumption) benefits. In order to correctly account for the "third" component, national economic accounts must be extended to encompass the valuation of leisure-time and the notion of increased "productivity" of future leisure-time due to current education and health expenditures. There is, however, no professional consensus on how leisure-time should be evaluated because of the absence of direct market indicators. Indeed this point leads naturally to the second "major pitfall" which will now be discussed. (Schultz's distinction between the "second" and "third" components listed above, was stimulated by Abba Lerner's comments.)¹³

So far the retrospective (or resource-cost) approach to estimation of human capital stocks and flows has been based on

observed expenditure data.¹⁴ It might be argued that if the estimation process is limited to such data, particularly formal actual expenditures on education and health, then it might be possible to achieve acceptable estimates without raising controversial issues. Indeed, this is the key point emphasized in an unpublished Statistics Canada paper (1985) on a topic closely related to the main concerns of the present paper. However, restricting the treatment of human capital in this manner is something like a presentation of "Hamlet without the Prince"! Indeed, those investigators who have utilized the resource-cost approach to estimation (such as Kendrick (1976) and Eisner (1985)) have, in addition, introduced a series of imputed (unobserved) costs (also called opportunity time costs) in order to present a more complete picture of human resource investment. It turns out that these imputed costs are often as important as the observed resource costs of human capital investment. Once the door is open to such imputation, in a national accounting context, then we are faced with a Pandora's box full of difficulties and subjective elements. Note that the estimation of physical capital stocks and flows is not subject to the "imputation" problem.

Briefly, some illustrations are as follows. As a minimum, we would need an imputed evaluation of students' time costs -- their foregone earnings when time is devoted to "investment" in education rather than work and current production. This is a major imputation item and different writers tend to use different

procedures, depending on implicit assumptions rather than market observations. (A similar time cost imputation is often required with respect to most formal training programs.) The work of Mincer (1962) shows that informal on-the-job training contains an implicit investment aspect as workers' accept lower wages in order to gain working experience. There is need for an imputation time allowance for this item. Indeed, "education" results not only from schooling and training, but also from general experience both at work and in leisure-time activities. No one has yet evaluated this phenomenon! In the field of health care development, it is also advisable to account for the imputed value of time spent on long-term (benefit) medical treatment (the counterpart of the imputed value of students' time for education). Again, there is presently no professional consensus on how these imputations should be constructed and entered in an extended national accounting context. But if these, and other human investment related imputations are made, then the door is open to a whole range of imputed evaluations and attributions that could completely change the character and nature of national accounts.¹⁵ It would be difficult, e.g., to exclude the evaluation of household work, child-rearing operations, do-it-yourself activities, volunteer work-time imputations, and a complete "costs evaluation" accounting of leisure-time activities. In fact some steps along these lines have been taken by Nordhaus and Tobin (1972) in their constructed measure of "Net Economic Welfare". But such a measure takes one considerably away from the task of

estimating human capital stocks and flows -- which is our main concern.

There are some other "pitfalls" of the retrospective approach to estimation of human capital. These are best discussed within the context of the second major approach to estimation, dealt with in the next section. The second approach, it will be seen, has some advantages over the first approach, but also possesses some distinct disadvantages which require an extended treatment. All this will then lead naturally to a third approach -- the "back-of-the-envelope" approach -- which, surprisingly, has been overlooked by many writers in this area.

IV. THE PROSPECTIVE ("PRESENT-VALUE") APPROACH

This second approach, to the main subject matter of the paper, directly provides estimates of total human capital stocks. Then investment is indirectly calculated from changes in the value of stocks over time. Also, the estimation process is typically performed in terms of net stocks and net investment, and depreciation (or appreciation) is implicitly derived as a by-product of the process. Therefore, the prospective ("present-value") approach has some significant differences compared to the retrospective ("resource-cost") approach discussed in the previous section. The second approach, in addition, has a more sophisticated flavour and is an approach more closely related to

the peculiarities of human capital stocks and flows rather than physical capital stocks and flows. There is no essential reason for utilizing the same methodological approach in the two fields of capital stock estimation, although there is some danger of losing the benefits of comparability when different approaches are employed.¹⁶ In fact the prospective approach can, in principle, be used to also estimate physical capital stocks and flows, but so far there has been no published work in this direction. We now describe the special features of the prospective approach with reference to estimation of human capital stocks and flows.

The prospective approach measures human capital stocks as the discounted present-value of expected lifetime earnings (or returns) of the human population. To implement this measure, various issues must be resolved. We must identify what is meant by returns to human capital and decide whether these returns should be net of some measure of human maintenance.¹⁷ The "returns" must be forecast into the future according to the expected life spans and labour force participation rates of the human population. In order to convert future returns to present values, an appropriate discount rate must be chosen. It will also be necessary to decide whether individuals engage in human investment after some chosen age cohort (a technical matter relating to implicit estimation of depreciation) and whether future earnings (or returns) are subject to an exogenous growth trend of unspecified origin. Finally, it should be noted that

future earnings may or may not be discounted at a constant rate across all age and education (and sex and occupational) categories. When the prospective approach is applied, it is common to assume that all returns to human capital are monetary¹⁸ and accrue solely to the individual (no distinction between "private" returns and "social" returns).

In this paper we will not discuss in detail each of the technical issues mentioned in the previous paragraph and their possible resolution. A good deal would depend on statistical data availability (e.g., census cross-section and survey longitudinal data) and the proposed scope of the human capital stock estimation procedure. In theory, however, it should be noted that the two approaches, retrospective and prospective, should yield approximately equal estimates over sufficiently long time periods. (But see also discussion in Postscript section.) The first approach estimates cumulative resource "costs" of investment, and the second estimates discounted present value of "returns" to investment.) At least this supposition should hold (or tend to hold true) when all capital markets exist and are in perfectly competitive equilibrium. But in fact, human capital markets per se do not exist. And current activities that add to human capital formation, such as education and health care, are certainly not competitive being subject to government subsidies and direct interventions. However, by manipulating the factors that go into the construction of the prospective approach (e.g., discount

factors), it is sometimes possible to produce estimates by the two approaches that are approximately equal (see Graham and Webb (1979)).

It appears that the prospective approach offers a resolution of some of the key pitfalls facing the retrospective approach. For example, the prospective approach is not dependent on explicitly identifying the full range of human capital activities and their investment expenditure portions. The activities might include such items as: good nutrition, physical recreation and urban cultural amenities. Similarly, the measurement of investment related to job experience ("learning by doing") is a difficult task within the retrospective (resource-cost) approach since the acquisition of such experience is often costless and so must be imputed by arbitrary procedures. There is also a range of human capital activities for which resource-cost data may not be reliable, e.g., the area of informal training costs incurred by business. Finally, we ultimately desire estimates of net investment and net stock of human capital. Procedures used to measure depreciation, within the retrospective approach, are entirely arbitrary and, in fact, based upon a false analogy with estimation of depreciation of physical capital stocks and flows.¹⁹ The prospective approach, on the other hand, features a "natural" measure of human capital depreciation: changes in the discounted present value of future returns that occur as the employed human population grows older plus the lifetime returns that are lost

when persons die, or emigrate, before retirement from the labour force. A typical underlying feature is one of appreciation followed by straight-line depreciation over the normal working life of the individual.

Nevertheless, the prospective approach has been rarely used to estimate human capital stocks and flows²⁰ -- at least compared to the retrospective approach. Why is this so? Estimates yielded by the prospective approach are sensitive to the measure of earnings viewed as returns to human capital. There are questions relating to whether earnings should be "before income tax" or "after income tax" as well as whether a net earnings measure (after essential "maintenance expenses") is appropriate. But more important is the fact that the prospective approach only works if observed earnings really measure the value of the marginal physical product of human capital. Almost all writers who experiment with this approach have ignored the possibility of disequilibrium and market discrimination and imperfections with respect to returns to human capital. (The one exception is Thurow (1970)). In addition, the prospective approach (based on cross-sectional estimation) is open to over-estimation of human capital stock when returns to older persons are used to "forecast" returns that will accrue in the future to younger persons. (The forecast may also include an exogenous growth assumption.) This is true because returns to older persons include on the-job training and experience that younger persons have not yet been through. (This aspect can

sometimes be overcome if longitudinal survey data are available.) There is also the problem of incorporating nonmarket returns to human capital, particularly if the estimation of human capital stock is meant to encompass both males and females.²¹ If nonmarket returns are incorporated, then both the product and income sides of national accounts must be extended in order to provide a balanced and complete picture.²² Finally the prospective approach is critically dependent on the choice of discount rate(s) and on the assumed exogenous growth in earnings when limited to cross-sectional estimation. (This latter factor again can sometimes be overcome if a decennial time series of census data are available together with interpolation assumptions.)

There is, however, one fundamental objection to the prospective approach which has evidently limited its application in economic policy contexts. The approach yields inter alia an estimate of total human capital stock, but without a categorical source disaggregation that may be useful for economic policy. We do not learn, e.g., to what extent formal education, or vocational training, or types of health care and medical programs, have each contributed to, say, growing Canadian human capital stocks over time. Indeed the approach implicitly values the entire bundle of human attributes, physical and mental, including native intelligence. The retrospective ("resource-cost") approach is not subject to this particular fundamental objection.²³ But this also

implies that the present-value approach is the easier one to implement and can be done at the lowest cost.²⁴ The approach, essentially, only requires data on cross-sectional earnings profiles according to past population by age-education-sex categories plus a strong dosage of assumptions within a demographic modelling framework. It is, of course, also possible to try both approaches and attempt some reconciliation of their differences. This possibility, among others, will be discussed in the final section of the paper after the "back-of-the-envelope" alternative is introduced.

The prospective (present-value) approach to estimation was the one originally favoured by human capital experts such as Schultz (1961), at least for theoretical reasons. But for practical purposes, the retrospective approach has dominated the field since the early 1960s. However, a very recent contribution by Jorgenson and Fraumeni (1988) has stimulated a revival of interest in the prospective approach. The new contribution builds upon a time series of U.S. decennial census data with a distinction between no less than 2196 population categories. The measurement of investment in human capital is based on a careful system of demographic accounts and human capital is defined in terms of lifetime "full" labour incomes for all individuals in the population. Full labour compensation is the sum of market labour compensation and nonmarket labour "compensation" for activities resulting in human capital and direct consumption of labour

services. The nonmarket returns to labour are estimated as the product of hours of nonmarket work and an imputed wage rate. Nonmarket hours equal 14 hours per day less hours in formal education and training and hours in market work.²⁵ The hourly wage rate is after taxes; it is based on an opportunity cost model that values nonmarket hours at a person's foregone after-tax wage rate. But all earnings are "gross", in the sense that there is no explicit allowance for human maintenance costs. All this is put together through a complete and extended system of balanced national income and product accounts for the U.S. covering the time period 1948-84. A real discount rate of 4 per cent is utilized to translate future lifetime earnings (both market and nonmarket) into present-value estimates. There is also an assumed 2 per cent per year growth in real returns (partly based on interpolation procedures). So the Jorgenson-Fraumeni paper appears to carry the prospective approach to its logical conclusion!

It will not be surprising to learn that the resulting estimates of human capital stocks and flows are largely dominated by imputed values of nonmarket production. Indeed all nonmarket time is imputed to human capital investment. This, together with the assumption (opportunity cost model) that values nonmarket hours at a person's foregone (after-tax) market wage rate, raises the following critical question. Why is it that investments in specialized market skills positively affect the "productivity" of

such nonmarket leisure activities as watching television or reading the newspaper?²⁶ Another question can be raised concerning the fact that human investment estimates are based on gross discounted full incomes: neither the cost of maintenance during working life nor the time and cost of rearing children (including accumulated interest) are considered. If maintenance costs were netted out, as they supposedly are for estimates of physical capital, then both the investment and stock estimates of human capital would be much smaller. Both these two key questions have been posed before in the literature, but there is no consensus on an appropriate applied methodological procedure.

The Jorgenson-Fraumeni contribution can also be questioned with regard to their implied assumption that the imputed value of a unit of nonmarket time is equal to the value of a unit of market time in each of the 2196 population categories. A little analysis will show that average hourly wage rates do not necessarily equal the marginal product of an additional hour of market time; the latter notion is the theoretically proper shadow price for nonmarket time. Indeed more direct studies suggest that the value of (nonmarket) time is significantly less than the average wage rate. So again there are built-in overestimates in the Jorgenson-Fraumeni procedures. But all this should not detract from the powerful display of accounting and statistical techniques embodied in their important contribution nor should it discourage other private investigators from embarking on such grand and

comprehensive designs. Some further comments comparing the Jorgenson-Fraumeni estimates, based on a "present-value" procedure, with those of Kendrick (1976), based on a "resource-cost" procedure, can be found in the concluding section of this paper.

V. THE "BACK-OF-THE-ENVELOPE" APPROACH

At several places in this paper it was suggested that there is a short-cut alternative approach to estimation of total human capital stock for a nation at a point in time. This approach is very crude, but yet may yield a reasonable approximation for general economic policy purposes. Indeed there is even some evidence that this short-cut alternative is now being used by one of the major originators of human capital theory (see below). Although the approach is essentially based on one very strong assumption, the resulting estimates do not appear to be unduly sensitive to this assumption. But once again it will be seen that the "back-of-the-envelope" approach is subject to the same fundamental objection experienced by the prospective approach described in the previous section. Our description of the short-cut alternative will, naturally, be very brief. But the alternative also presents an opportunity to clarify some conceptual and quantitative matters that have so far been neglected in this paper.²⁷

Simply put, the approach is essentially based on the assumption that the economy-wide rate of return to human capital is equal to the economy-wide rate of return to nonhuman capital. Since the rate of return to any capital (stock) asset is defined as the current dollar total return to the asset divided by the current dollar total value of the asset, we can easily see what is involved in this short-cut approach. Suppose that three-quarters of current dollar national income is a return to labour (i.e., the total return to human capital equals about three-quarters of national income). The remaining one-quarter of national income is then the total return to nonhuman capital. So, based on the above assumption combined with the above definition and supposition, we must conclude that three-quarters of the economy's total capital stock (or total "wealth") would be composed of human capital stock; the remaining one-quarter of the economy's total wealth would be composed of nonhuman capital stock. Finally, if estimates are available of the economy's total nonhuman capital stock, then we can estimate the economy's total human capital stock by simply multiplying the former estimate by the number three. Simple enough, but in the process certain conceptual and statistical subtleties have been overlooked.

There is first the problem of dividing total national income into the two major components: (1) a total return to human capital and (2) a total return to nonhuman capital. There are certain intermediate cases such as the earnings of the

(professionally) self-employed and the entrepreneurial income of unincorporated business where the distinction is not clear cut. The concept of national income embodies various transaction and valuation adjustments that are difficult to allocate to returns to either human or nonhuman capital. Also in order to implement the short-cut procedure we would need a prior estimate of total nonhuman capital stock, including nonreproducible physical wealth (e.g., land) and nonhuman intangible wealth (e.g., the stock of knowledge directly created by research and development expenditures). The latter factor is often difficult to distinguish from aspects of human education outlays.²⁸ More important is the implicit limitation of the "back-of-the-envelope" approach to observed market incomes and market returns to human capital. We already know that nonmarket returns to human capital cannot be ignored at the risk of presenting "Hamlet without the Prince." It is equally evident that the approach is once again subject to the fundamental objection raised with respect to the prospective approach discussed in the previous section. Even in the best of circumstances, the short-cut procedure is not capable of identifying the precise sources of human capital wealth; the entire aggregate bundle of human attributes, both physical and mental, are valued in one total stock estimate.

There is, however, an even more important defect of the above approach. A major goal in measuring human capital stocks is to be able to estimate rates of returns to these forms of national

wealth. In particular, we would normally be interested in comparing rates of return to human capital with rates of return to physical (and other nonhuman) capital stock. Assuming that the two sets of rates of return are equal is equivalent to "assuming away" a major problem and a major "unknown"! In fact there is considerable theoretical (and some empirical) evidence that one should expect the general rate of return to human capital to exceed the general rate of return to nonhuman capital. This expectation is closely related to considerations of differential risk, liquidity, and bequeathability of human wealth vis-à-vis nonhuman wealth. There are also (probability) considerations of mortality and disability that affect expected returns to human capital, as well as the key question of differential taxation of the two major sources and uses of national income. So human wealth must somehow be estimated in more indirect ways than most components of nonhuman wealth whose asset values can be determined via the market. And convenient assumptions are not a substitute for the need for these "more indirect ways".

Nevertheless it does appear that the "back-of-the-envelope" approach to estimation has been utilized by at least one leading exponent of human capital theory. In a recent article in Business Week Magazine, Gary Becker (1987) claims that human wealth constitutes 75 per cent or more of the U.S.'s total wealth. The estimate was evidently made by the above procedure since the relevant measure is "too large" to follow from Kendrick's (1976)

retrospective approach and "too small" to follow from Jorgenson's (1988) prospective approach.²⁹ The "back-of-the-envelope" approach is also mentioned in Boskin (1988). So before closing this section it might be helpful to know that this approach can still be used when the basic assumption underlying the approach are relaxed and replaced by weaker assumptions. A recent paper explaining the technicalities is summarized in the Postscript.

VI. WHAT CAN BE DONE IN THE FUTURE?

"I confess that I have never been entirely happy with the "human capital" approach to education. I don't doubt at all that there is an investment-like element in education, with the return coming in subsequent higher productivity and wages. But I have deliberately said "investment-like" because it is not precisely clear to me that what education creates is properly a stock. It is even less clear to me that it is appropriate to add the stocks belonging to different people. I have the impression that the human capital theorists have tended to ignore -- and therefore to underestimate -- the consumption component of education. It has seemed to me also that they have failed to analyse the consequences for the social valuation of education of the possibility that diplomas and degrees function in part as a kind of signaling or screening device for certain traits and habits, and not simply as a scale measuring the volume of a stock accumulated. So I would have to be convinced that the right thing to do is to treat all educational expenditures as gross investment."

Robert M. Solow (1973)

Fifteen years after the so-called human capital "revolution", a leading economist continued to express grave doubts about the field. And in the considered opinion of the present writer, such doubts continue to this day.

To be clear, there is professional agreement that the theoretical concept of human capital is on reasonably safe ground. In general, economics recognizes capital as a stock which has value as a source of current and future flows of output and income. In particular, human capital is the stock of skills and productive capacities embodied in human beings as income-producing agents in the economy. The return on human capital investments lies in enhancing the individuals' earning powers and increasing the efficiency of decision making within the economy. We are not wasting our time looking at human capital, its problems and prospects. All is well, conceptually speaking. There is, however, no consensus regarding the estimation and identification of human capital stocks and flows, particularly within a national economic accounting framework. Estimates produced for the U.S. by Jorgenson and Fraumeni (1988), using the prospective approach, differ from those yielded by Kendrick (1976) and Eisner (1985), using the retrospective approach, by an order-of-magnitude of some 10- or 20- fold! Even within the retrospective approach there are grave defects. Both Kendrick and Eisner completely neglect the consumption component of education and arbitrarily assume that some 50 per cent of total U.S. health care expenditures constitute gross investment. Gates (1984), in a more careful analysis of human gross health investment, estimates that some 25 per cent of total U.S. health care expenditures can be considered "investments" and even this more careful analysis is subject to radical revision.

Therefore we may conclude that human capital estimation performed for the U.S. economy does not yet provide appropriate guidelines for future empirical work in Canada. Both the prospective (present-value) and retrospective (resource-cost) approaches are open to severe limitations. In this concluding section we will not attempt to summarize point-by-point the substance of the previous Sections III and IV. But the structural characteristics of the Canadian economy are sufficiently similar to those of the U.S. economy so that we may generalize on the basis of U.S. experience with human capital estimation. Indeed the "back-of-the-envelope" approach to estimation of Canadian human capital stocks (and flows) probably offers the most cost-effective procedure at the present time. With some reasonably appropriate assumptions we can produce, in short order, some "ball-park" estimates of Canadian human capital stock vis-à-vis Canadian nonhuman capital stock). This, in fact, is our first statistical policy recommendation (see also Postscript to follow).

As already implied, the two major approaches to estimation of human capital stocks and flows are currently faced with a series of technical difficulties. These problems pose a serious challenge to the economics profession. It would, therefore, not be advisable for Canadian government institutions, mainly interested in applied economics and statistics, to embark on a long-term research investigation of the fundamental empirical

problems in the human capital area. Rather it would seem that Canadian private investigators, particularly in the academic field, should be actively encouraged to take up these technical problems, possibly with the financial support of the Canadian government. Indeed, the present paper could serve as an introduction to some of the major challenges in the area. Once the academics have managed to resolve the key technical issues and obtain a reasonable consensus on their proposed resolutions, then Canadian government institutions will be prepared to apply their resources in the way, e.g., estimation of GNP was first implemented and standardized.

To conclude the paper it may be helpful to provide comments on a number of additional issues on the periphery of human capital estimation. These issues were mainly overlooked due to the limited scope and purpose of this paper: estimation and identification of Canadian human capital stocks and flows in the context of a national economic accounting framework. Our treatment of the selected issues is kept very brief.

Canadian research and development (R&D) expenditures are officially classified as either intermediate consumption, when financed by the business sector, or as final consumption, when financed by government. There is now a growing consensus that R&D outlays are primarily a flow of investment; their consumption component is negligible. In effect, R&D represents a nonhuman

intangible type of investment (and is sometimes difficult to distinguish from certain types of education and health expenditures). In this case it is easy to apply the retrospective (resource-cost) approach to estimation and identification of R&D investment flows and capital stocks, since the two major pitfalls of the approach are essentially absent. There are technical problems relating to expected life spans and amortization of R&D, but these problems can usually be handled in a reasonable fashion. Indeed, Statistics Canada (1987) is presently proceeding with some work along these lines. This work provides useful background and experience for any future work on estimation of Canadian human capital stocks and flows.

So far in this paper we have neglected the whole area of "human resource accounting" at the level of the business firm. About 20 years ago there was a serious movement among business accountants to encourage business firms to account for their employees as human capital assets on the firms' balance sheets. The movement, however, was short-lived and the practice is now evidently rare and possibly non-existent. We will not dwell on the reasons why "human resource accounting" never took off. But there is one existing practice closely related to human resource accounting that warrants investigation. It appears that human capital may be registered as an asset in certain firms' balance sheets prepared in conformity with business accounting conventions. For example, business corporations organized for the

management of artists, entertainers or similar professionals, may include the discounted present value of their clients' future net earning capacity as a human capital asset in the firms' balance sheets. Perhaps there are some lessons to be learned from these cases that can be generalized for our purposes. (This is the one "exception: originally mentioned by Goldsmith in our footnote number one.)

There is no doubt that the prime sources of human capital can be located somewhere along the range of expenditures (both actual and imputed) on: education, training, health care, medical programs, labour mobility, nutrition practices, and general safety measures (one might even add cultural activities and environmental protection). Many of these are social fields that have recently been the subject of analysis by a new tool called: The French System of Satellite Accounts. Briefly, the Accounts provide a consistent statistical framework for analyzing the three major economic aspects of any social field: (1) who finances the field (including transfer payments), (2) which are establishments that produce the services relevant to the field, and (3) who ultimately benefits from expenditures in the social field. The Accounts are then capable of spelling out all the economic linkages between these three major aspects. Once again there may be some lessons to be learned from careful study of the French System and of applications of Satellite Accounts. The Accounts sometimes draw distinctions between consumption and investment

that are reminiscent of unsolved problems in the human capital area. The Accounts also distinguish between actual expenditures and imputed opportunity time costs.

Finally this paper has not become involved in the special tasks of, e.g., the "economics of education", or "economics of health". There is, nevertheless, a close relationship between these specialties and the main concerns of our paper. For example, the economics of education attempts inter alia to measure and compare rates of return on "investment" in various categories of education and training. These attempts essentially bypass the major estimation problems dealt with in this paper by using various indirect manipulations for comparative purposes. The economics of education also has a more micro- and process-oriented flavour in contrast to the macro-and sectoral-oriented flavour of human capital estimation in a national accounting framework. Still, many of the concerns faced by the economics of education such as: the "built-in correlation bias" (via native ability) between high incomes and education, and education as a "signaling or screening device" (à la Solow (1973)) are relevant in one way or another to the identification problems of this paper. It should be noted, however, that education is only one possible aspect of human capital. We must cast our net in a sufficiently broad fashion to be sure of not overlooking potential sources of human capital that have not yet become the subject of economic specialties.

NOTES

1. Goldsmith does make one minor exception to this generalization, that will be mentioned later in this paper.
2. A more "neutral" exposition of the field can be found in Thurow (1970).
3. Most of the literature deals with education and training; health expenditures as "investment" was first analyzed in Mushkin (1962) and labour mobility expenditure in Sjaastad (1962).
4. Some empirical estimates of the "understatement" are given later in this paper, but the emphasis is mostly on conceptual clarification and application.
5. We should also add the investigation of Jorgenson and Fraumeni (1988).
6. There is also the problem of price deflation (or reflation) needed to put current expenditure data over time on a comparable valuation basis.
7. Further details are available in Kendrick (1976).
8. Some further discussion of this point will be found later in the paper.
9. These two percentage figures translate into \$1,227 and \$1,465 respectively on a per capita basis for the year 1984.
10. This is simplification for present purposes (see later discussion).
11. A good discussion of this issue can be found in Usher (1973) whose "warnings" on the subject have tended to be overlooked by later writers. But Usher's work is very much in the spirit of the original Schultz (1961).
12. Firm-specific expenditures on education and health, performed within the business sector, are not subject to the economy-wide demographic techniques, but are handled according to average duration of employment with the business firm.

13. There is an additional technical complication pointed out by Jaszi (1971). The reclassification of items from "official" consumption to "human" investment implies the imputation of a rate of return on the investment which then might be categorized as consumption under certain assumptions. We will not, however, pursue this complication.
14. Except for the problems of leisure-time valuation discussed above.
15. The whole range of imputations are formally needed to maintain "comparability" (ratio) estimates.
- 16 This is emphasized by Goldsmith (1982) and some European continental writers on the subject.
- 17 Just as the returns to physical capital stocks are measured in terms of net revenue (or profit earned) after subtracting maintenance costs. A good introduction to some of the issues can be found in Gates (1982). More precise formulations are in Graham and Webb (1979).
- 18 There is one very important exception to this assumption, namely Jorgenson and Fraumeni (1988) which will be discussed shortly.
- 19 A good analysis of this issue can be found in Hawrylyshyn (1978).
- 20 This writer is only aware of Weisbrod (1961) and Graham and Webb (1979). But see also Hawrylyshyn (1978) and Jorgenson and Fraumeni (1988) discussed below.
- 21 The early applications of the prospective approach were limited to estimation of human capital stock embodied in the male population only!
- 22 This is accomplished in the recent contribution of Jorgenson and Fraumeni (1988).
- 23 This point is clearly made by Kendrick (1976) and indirectly by Gates (1982).
- 24 See also discussion in the next section of the paper.
- 25 This implies that nonmarket returns to household work are included together with almost all leisure activities.
- 26 Thanks are due to Sherwin Rosen (1988) for clarification of this issue.
- 27 The exposition of this section was aided by a reading of Boskin (1988).

- 28 This is mentioned again in the next section of the paper. It should also be noted that the exposition here assumes a closed economy so that all financial assets are netted out by corresponding financial liabilities at the national level.
- 29 Jorgenson's estimates have been privately available for a number of years prior to publication.

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POSTSCRIPT

The main text of this paper was prepared and written during the Spring and Summer of 1988. Since that time there have been no major contributions to the field, at least to this writer's knowledge, that would alter the main analysis and conclusions of the paper. So it seems best at the present moment not to introduce significant changes in the main text. The text, therefore, is essentially the same as the one compiled during the year 1988.

There have, however, been some new developments in the area of human capital and closely related issues during the past 12 months. Also, as a researcher monitors new developments, it is natural to become aware of past developments that were "missed" at the time of the original writing. The main purpose, then, of this Postscript is to briefly inform the reader of the new (post mid-1988) developments and the older developments that were overlooked. In fact, one of the "new developments" is an application of the "back-of-the-envelope" approach to estimation of Canadian human capital stocks recently presented by this writer at an international conference (see again Section V of the main text.) The results of that application are briefly summarized below. In any event, the reader should not expect anything very "startling" to be revealed in this Postscript. Most of the

developments, outlined here, simply confirm what has already been exposed in the text. But one or two items, of potential importance for future research on human capital, are highlighted.

It seems best to begin with an unpublished paper prepared by Sir Richard Stone (1974) for the United Nations Statistical Commission. (The paper was unavailable to the present writer until very recently.) The Stone paper covers a wide range of issues relating to the question of "supplementing" the national accounts for purposes of welfare measurement. One of the issues concerns the "proper" distinction between current and capital expenditures reminiscent of our previous discussion in Section III. And an important aspect of this particular issue is the problem of identifying and measuring human capital stocks and flows. The Stone analysis raises many complexities that must be resolved before estimation of human capital can proceed in a successful manner. His conclusions are worth quoting:

"It is considered that the concept of human capital as a measure of discounted earning capacity over a lifetime and that the concomitant treatment of educational and other outlays thought to increase this capacity as fixed capital formation, should not be introduced in the national accounts. Forbidding problems and difficulties arise in attempts to evaluate the stream of future earnings of individuals; the contributions of various outlays and other factors to bringing about long-term improvement in this capacity have not been clearly established; at least an undetermined and varying portion of the outlays on, e.g., education are a form of consumption that do not increase the earning and related

performance capacities. These questions should undoubtedly be (further) explored...."

Fourteen years later Robert Eisner (1988), in a comprehensive survey article of extended accounts for national income and product, raises many of the same issues discussed by Richard Stone; see especially Eisner (1988, pp. 1623, 1634 and 1637). It turns out that the key questions have been "further explored", but not yet resolved. There is still at the present time no consensus on how human capital stocks and flows should be identified and estimated within or without a national economic accounting framework. And the latest word from the United Nations Experts Report (1989) is that human capital stocks and flows are best considered outside a national accounting system. Indeed, at this moment it is difficult to think of more than one economic research team that is currently engaged in estimation of human capital stocks and flows on a national basis. There is, however, some activity directed to implementing "short-cut" procedures for estimation purposes based on certain assumptions (mentioned again below).

About three years ago there was a paper by Kroch and Sjoblom (1986) that investigated certain aspects of the prospective ("present value") approach to estimation of human capital (see again Section IV of the main text). The paper focused on "schooling wealth", i.e., the capitalized value of educational

improvements made to labour. One by-product of this work is a partial explanation for the divergence of human capital estimation results obtained by the retrospective ("resource-cost") approach as compared to the prospective approach. It appears that the latter approach is capable of capturing the impact of relatively high inframarginal returns to human capital investment, since the (average) rate of return on inframarginal investments normally exceeds the discount rate utilized by the prospective approach. So the prospective approach to estimation should yield results greater than the retrospective approach based on the accumulated resource costs of inputs into human capital investment. In a perfectly competitive equilibrium, the two approaches to estimation are "only" equal at the "margin". This is an important point. But the proposed "divergence explanation" does not help resolve the many conceptual and empirical problems needed to successfully implement either the retrospective or the prospective approaches to estimation of human capital stocks and flows. These problems, for each of the approaches per se, have already been discussed at some length in the text of this paper.

The paper, however, does overlook one important contribution that is already almost 10 years old. The originator of human capital theory in economics, Theodore Schultz (1980), after a gestation period of some 20 years, re-oriented his view of human capital away from education and formal training (expenditures)

per se and towards entrepreneurship, broadly defined. There is a highly "embarrassing" situation that the individuals with the highest earned incomes (broadly defined) in Canada are often not the most educated or the ones with the most extensive formal training. These outstanding individuals are actively contributing to total Canadian incomes primarily by means of their entrepreneurial ability. One might say the following: Canadian human development expenditures on education, training, health and medical care, mobility, nutrition, safety programs and even research and development are all very nice! But what is the essential ingredient that "puts it all together"? That ingredient, in the view of Schultz (1980) and most recently Casson (1988), is the entrepreneurial aspect of human capital.

But where does this "entrepreneurial human capital" ultimately come from? It appears, according to Casson (1988), that human personality and cultural factors play a key role. The entrepreneur is someone who specializes in taking judgmental decisions about the allocation of scarce resources. The essence of such decision making is that the outcome critically depends on who makes the decision. The most successful entrepreneurs are personally characterized by: self-confidence, breadth of experience, and mental flexibility. These are all encouraged by an educational background emphasizing independent critical judgment rather than rote-learning. A social and cultural

background devoid of extreme political, racial or religious intolerance is also beneficial. The most important ingredient, however, seems to be mental flexibility -- encouraged through creative and imaginative leisure activities of an artistic, dramatic or religious nature. Would the Reichman Brothers please stand up!!

Although human capital stocks and flows are difficult to identify and estimate, there is a growing need today to establish some "ball-park" estimates of the relative importance of human capital stock in a nation's economy. Some examples of where such estimates can be utilized in current economic analysis can be found in Becker (1987) and Boskin (1988). These considerations motivate the "back-of-the-envelope" approach to human capital estimation outlined in Section V above. The approach is based on two highly restrictive assumptions. But Postner (1989) has demonstrated that the assumptions can be (partly) relaxed: (1) the rate of return to human capital need not equal the rate of return to nonhuman capital, and (2) total labour income need not be identified as the total return to human capital. The assumptions can be replaced by simulations in such a manner that meaningful "ball-park" estimates of human capital stocks and flows can still be obtained. Moreover, the procedure reveals the sense in which human capital stocks and flows have become relatively more important over time in advanced industrial nations. There are,

however, definite limitations to how far one may go with this "short-cut" procedure. In effect, the procedure has an "interim" value pending the realization of a professional consensus on a more elaborate methodology needed for estimation of human capital stocks and flows.

The main empirical result obtained in Postner (1989) is as follows. An application to Canada for the year 1988 shows that Canadian human capital stock (in gross terms) is significantly more important than Canadian nonhuman capital stock (gross terms). As a "ball-park" estimate, Canadian human capital stock probably comprises about 60 per cent of total Canadian income-producing wealth, on a gross consolidated basis, and measured with respect to the domestic market economy. And perhaps most important, this estimate is almost trivial to perform and is straightforward to interpret.

Finally, to close this Postscript it seems appropriate to offer a quotation from Boulding (1988):

"The fact that some human beings have a negative human capital both for themselves and for society, cannot be overlooked, though our social accounting is ill-equipped to deal with this problem. In political decisions, however, we do recognize it. The criminal justice system is at least intended to diminish negative human capital; the educational system is intended to increase positive human capital. The fact that there is very little capital accounting in government means that considerable parts of its activity...do not really have

a "bottom line", and their value is usually assessed in non-economic terms, which can easily lead into catastrophic mistakes of judgement."

Needless to say, the "economics of crime and punishment" is an area that appears ripe for further development and, perhaps, the idea of "negative human capital" can play a key role in that respect.

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